



5.4.5 Flood

The following section provides the hazard profile (hazard description, location, extent, previous occurrences and losses, probability of future occurrences, and impact of climate change) and vulnerability assessment for the flood hazard in Morris County.

2015 Plan Update Changes

- The hazard profile has been significantly enhanced to include a detailed hazard description, location, extent, previous occurrences, probability of future occurrence, and potential change in climate and its impacts on the flood hazard is discussed. The flood hazard is now located in Section 5 of the plan update.
- New and updated figures from federal and state agencies are incorporated.
- Previous occurrences were updated with events that occurred between 2010 and 2014.
- A vulnerability assessment was conducted for the flood hazard and it now directly follows the hazard profile.

5.4.5.1 Profile

Hazard Description

Floods are one of the most common natural hazards in the U.S. They can develop slowly over a period of days or develop quickly, with disastrous effects that can be local (impacting a neighborhood or community) or regional (affecting entire river basins, coastlines and multiple counties or states) (FEMA 2008). Most communities in the U.S. have experienced some kind of flooding after spring rains, heavy thunderstorms, coastal storms, or winter snow thaws (George Washington University 2001). Floods are frequent and costly natural hazards in New Jersey in terms of human hardship and economic loss, particularly to communities that lie within flood-prone areas or floodplains of a major water source.

Flooding in Morris County is the result of heavy rainfall produced by hurricanes, thunderstorms, flash flood and severe winter storms. Many areas of Morris County are susceptible to localized flooding from excess rain events, stormwater runoff, urban flooding, local drainage problems, and overbank flooding. All municipalities in the County have experienced some degree of flooding (Morris County HMP 2010).

The main type of flooding in Morris County is riverine flooding. Riverine floods are the most common flood type. They occur along a channel and include overbank and flash flooding. Channels are defined, ground features that carry water through and out of a watershed. They may be called rivers, creeks, streams, or ditches. When a channel receives too much water, the excess water flows over its banks and inundates low-lying areas (FEMA 2008; The Illinois Association for Floodplain and Stormwater Management 2006).

Flash floods are “a rapid and extreme flow of high water into a normally dry area, or a rapid water level rise in a stream or creek above a predetermined flood level, beginning within six hours of the causative event (e.g., intense rainfall, dam failure, ice jam). However, the actual time threshold may vary in different parts of the country. Ongoing flooding can intensify to flash flooding in cases where intense rainfall results in a rapid surge of rising flood waters” (National Weather Service [NWS] 2009).

Additionally, riverine flooding can lead to stormwater and urban drainage flooding in Morris County. Stormwater flooding described below is due to local drainage issues and high groundwater levels. Locally, heavy precipitation may produce flooding in areas other than delineated floodplains or along recognizable channels. If local conditions cannot accommodate intense precipitation through a combination of infiltration and surface runoff, water may accumulate and cause flooding problems. During winter and spring, frozen ground



and snow accumulations may contribute to inadequate drainage and localized ponding. Flooding issues of this nature generally occur in areas with flat gradients and generally increase with urbanization which speeds the accumulation of floodwaters because of impervious areas. Shallow street flooding can occur unless channels have been improved to account for increased flows (FEMA 1997).

High groundwater levels can be a concern and cause problems even where there is no surface flooding. Basements are susceptible to high groundwater levels. Seasonally high groundwater is common in many areas, while elsewhere high groundwater occurs only after a long periods of above-average precipitation (FEMA 1997).

Urban drainage flooding is caused by increased water runoff due to urban development and drainage systems. Drainage systems are designed to remove surface water from developed areas as quickly as possible to prevent localized flooding on streets and other urban areas. They make use of a closed conveyance system that channels water away from an urban area to surrounding streams. This bypasses the natural processes of water filtration through the ground, containment, and evaporation of excess water. Since drainage systems reduce the amount of time the surface water takes to reach surrounding streams, flooding in those streams can occur more quickly and reach greater depths than prior to development in that area (FEMA 2008).

Location

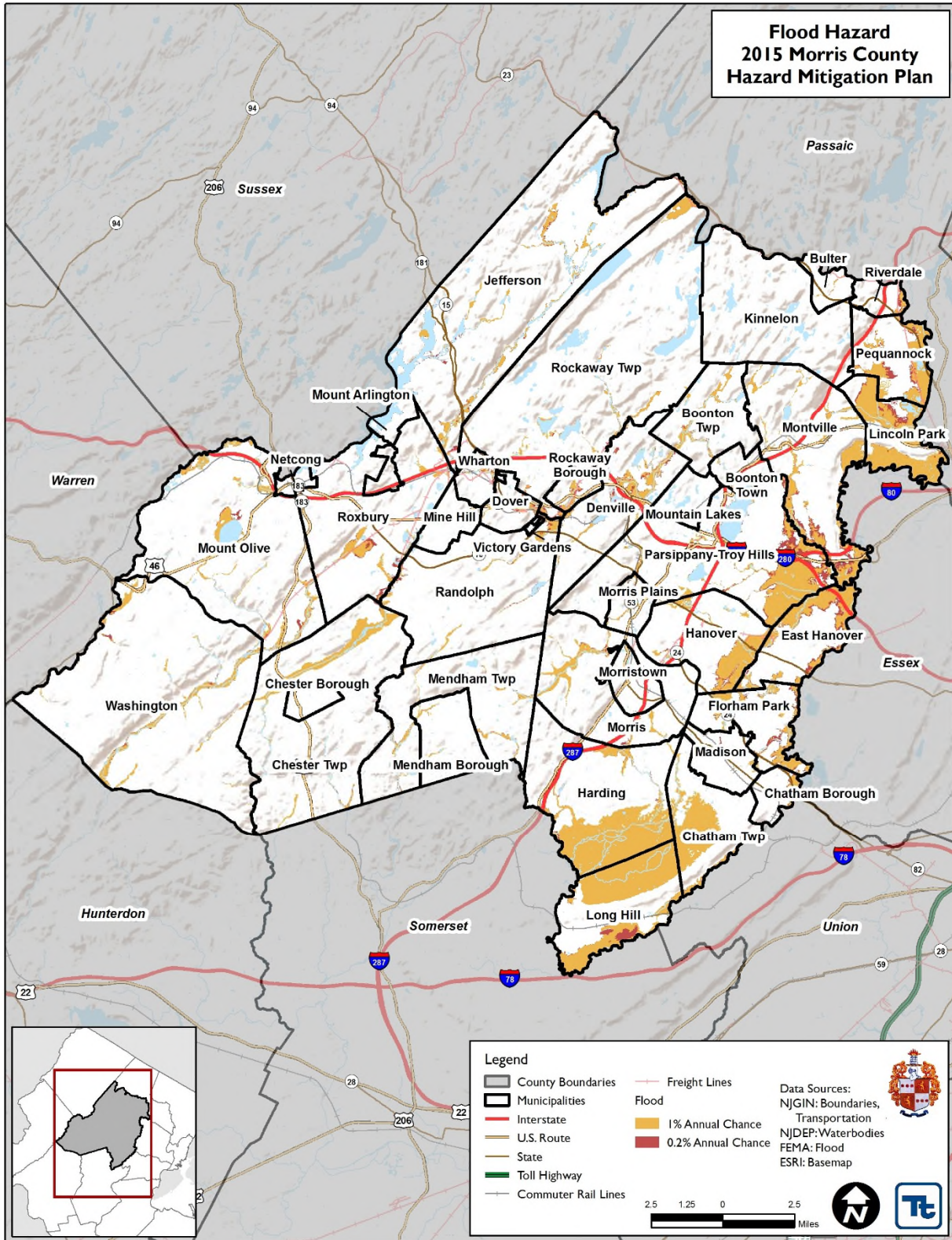
The County is partially bordered to the north by the Pompton and Pequannock Rivers, which forms the border between Morris and Passaic Counties. In the northeastern section of the County, the Passaic River forms the border between Essex and Morris Counties (Morris County HMP 2010). Over the years, Morris County has been impacted by flooding, especially in the municipalities situated adjacent to rivers.

A floodplain is defined as the land adjoining the channel of a river, stream, ocean, lake, or other watercourse or water body that becomes inundated with water during a flood. Most often floodplains are referred to as 100-year floodplains. A 100-year floodplain is not a flood that will occur once every 100 years, rather it is a flood that has a 1% chance of being equaled or exceeded each year. Thus, the 100-year flood could occur more than once in a relatively short period of time. Due to this misleading term, FEMA has properly defined it as the 1% annual chance flood. This 1% annual chance flood is now the standard used by most federal and state agencies and by the NFIP (FEMA 2002).

The 1% annual chance of flood hazard zones in Morris County are shown in Figure 5.4.5-1. A majority of the 1% annual chance flood hazard zones are located in eastern Morris County, along the Pompton and Passaic Rivers. In southwestern Morris County, the Black River has areas of the 1% annual chance flood hazard zones.



Figure 5.4.5-1. FEMA Flood Hazard Areas in Morris County



Source: FEMA 2012, 2015
FEMA Federal Emergency Management Agency





Floodprone Areas in Morris County

Currently, New Jersey ranks second nationwide for repetitive loss properties, second only to Louisiana. There are three major basins in Morris County: the Delaware, Passaic and Raritan. Well over half of Morris County is located in the Passaic River Basin (PRB), which has historically suffered the most from flooding. . From 2010-2012, there were 9 nationally-declared flood disasters and several “100 year” floods in the PRB. Of the 30 major floods from 1955-2012, 9 floods occurred between 1955 and 1985 (30 years) and 21 floods occurred from 1992-2012 (20 years) - this represents a 233% increase in major flood events. (FEMA, Passaic River Basin Workshop, 2012).

Analysis of 90+ years (1922–2015) of stream gage data from USGS gages throughout Morris County reveal that over 50% of these major floods have occurred in the past 12 years. Increases in average annual peak flows in Morris County rivers as measured by USGS stream gages in 10-20 year increments, range from 40% to 133% over a 90+ year period (Morris County Flood Mitigation Program 2015).

The major rivers creating significant floodprone areas in Morris County are: Passaic River, Pompton River, Rockaway River and Whippany River (FEMA FIS 2015). Please refer to Section 9 (Jurisdictional Annexes) for information regarding specific areas of flooding within each municipality.

Passaic River

The Passaic River is one of the major flood areas throughout Morris County. Municipalities flooded by the Passaic River include: Chatham Borough, Chatham Township, East Hanover, Florham Park, Hanover, Harding, Lincoln Park, Long Hill and, Montville (FEMA FIS 2015). Additionally, stream gage data analyzed in 20-year increments from USGS no. 0137900 in Millington/Chatham, and USGS no. 01389500 in Little Falls indicate an increase of 40% in average annual peak flow as measured from 1922-2011 (Morris County Flood Mitigation Program 2015).

The source of the Passaic River begins near the Borough of Mendham (Morris County) where small streams come together to form a brook where the River continues through open farm land and eventually winding through seven counties, 45 municipalities, and into the Newark Bay. At its source, the River is approximately 600 feet above sea level and flows along for approximately 90 miles. The River’s southeasterly flow goes south of Jockey Hollow at Morristown national Historical Park and becomes the boundary between Somerset and Morris Counties, east of Bernardsville and Basking Ridge and southwest of the Great Swamp National Wildlife Refuge (Morris County HMP 2010).

When the Passaic River reaches Morris County, through a wide valley, wetlands and marshes. At this point, it divides Morris and Essex Counties, flowing slowly past Livingston, Florham Park, Hanover and East Hanover, the Caldwells, Montville, Fairfield, and Lincoln Park. The Rockaway River joins the Passaic River at Pine Brook at the southeast end of Hook Mountain. At this point, its flow is turned directly between Fairfield and Lincoln Park to Two Bridges and is joined by the Pompton River. It then continues northeast into Passaic County and flows into Newark Bay (Morris County HMP 2010).

Pompton River

The Pompton River is a tributary of the Passaic River, it is formed by the confluence of the Ramapo and Pequannock rivers. It flows south, passing between Lincoln Park and Pequannock. Located in the northeastern section of Morris County, the Pompton River significantly floods areas in Lincoln Park and Pequannock; the two most flood-prone municipalities in Morris County. Stream gage data analyzed in 10-year increments from USGS no. 01388500 in Pompton Plains indicate an increase of 133% in average annual peak flow as measured from 1920-2011 (Morris County Flood Mitigation Program, 2015).



Rockaway River

The Rockaway River originates in Jefferson Township and flows to the southwest and then to the east, emptying into the Boonton Reservoir. The River flows through the Townships of Jefferson, Rockaway, Denville, Boonton, Randolph, and the Boroughs of Wharton, Rockaway, and the Towns of Boonton and Dover (Morris County HMP 2010).

Municipalities that have flooded due to the Rockaway River include: Town of Boonton, Denville, Jefferson, Parsippany-Troy Hills and Rockaway Twp. In August 2011, the Rockaway set a new flood record, carving out a section of Interstate 287 and causing two major slope failures in the Town of Boonton. Stream gage analysis in 20-year increments of USGS no. 01380500 in Boonton from 1938-2011 show an increase in average annual peak flow of 84% (Morris County Flood Mitigation Program, 2015).

Whippany River

The Whippany River is a major tributary of the Rockaway River. It rises in Mendham Township and flows East-North-East until it joins the Rockaway River in Hatfield Swamp, just above the confluence of the Passaic River.

The following municipalities are flooded by the Whippany River: East Hanover, Morris Township, Morristown, and Parsippany-Troy Hills. Stream gage analysis in 20-year increments of USGS no. 01381500 in Morristown shows an increase of 66% in average annual peak flow of the Whippany since 1921.

Extent

In the case of riverine flood hazard, once a river reaches flood stage, the flood extent or severity categories used by the NWS include minor flooding, moderate flooding, and major flooding. Each category has a definition based on property damage and public threat:

- Minor Flooding - minimal or no property damage, but possibly some public threat or inconvenience.
- Moderate Flooding - some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary.
- Major Flooding - extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations. (NWS 2011)

The severity of a flood depends not only on the amount of water that accumulates in a period of time, but also on the land's ability to manage this water. The size of rivers and streams in an area and infiltration rates are significant factors. When it rains, soil acts as a sponge. When the land is saturated or frozen, infiltration rates decrease and any more water that accumulates must flow as runoff (Harris 2001).

The frequency and severity of flooding are measured using a discharge probability, which is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. Flood studies use historical records to determine the probability of occurrence for the different discharge levels. The flood frequency equals 100 divided by the discharge probability. For example, the 100-year discharge has a 1% chance of being equaled or exceeded in any given year. The “annual flood” is the greatest flood event expected to occur in a typical year. These measurements reflect statistical averages only; it is possible for two or more floods with a 100-year or higher recurrence interval to occur in a short time period. The same flood can have different recurrence intervals at different points on a river.

One hundred-year floodplains (or 1% annual chance floodplain) can be described as a bag of 100 marbles, with 99 clear marbles and one black marble. Every time a marble is pulled out from the bag, and it is the black marble, it represents a 100-year flood event. The marble is then placed back into the bag and shaken up again before



another marble is drawn. It is possible that the black marble can be picked one out of two or three times in a row, demonstrating that a “100-year flood event” could occur several times in a row (Interagency Floodplain Management Review Committee 1994).

The 'base flood', previously known as the '100-year flood' is the floodplain management standard used by most federal and state agencies, including the NFIP. Inclusion within the base flood area (Special Flood Hazard Area or SFHA) determines the need for flood insurance. A structure located within a SFHA shown on an NFIP map has a 26% chance of suffering flood damage during the term of a 30-year mortgage.

The extent of flooding associated with a 1% annual probability of occurrence (the base flood or 100-year flood) is used as the regulatory boundary by many agencies. Also referred to as the SFHA, this boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities. Many communities have maps that show the extent and likely depth of flooding for the base flood. Corresponding water-surface elevations describe the water elevation resulting from a given discharge level, which is one of the most important factors used in estimating flood damage.

The term “500-year flood” is the flood that has a 0.2% chance of being equaled or exceeded each year. The 500-year flood could occur more than once in a relatively short period of time. Statistically, the 0.2% (500-year) flood has a 6% chance of occurring during a 30-year period of time, the length of many mortgages.

The 500-year floodplain is referred to as Zone X500 for insurance purposes on FIRMs. Base flood elevations or depths are not shown within this zone and insurance purchase is not required in this zone.

Previous Occurrences and Losses

Many sources provided flooding information regarding previous occurrences and losses associated with flooding events throughout Morris County. With so many sources reviewed for the purpose of this Hazard Mitigation Plan (HMP) Update, loss and impact information for many events could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP.

Between 1954 and 2014, FEMA declared that the State of New Jersey experienced 26 flood-related disasters (DR) or emergencies (EM) classified as one or a combination of the following disaster types: hurricane, tropical storm, Nor'Easter, snowstorm, severe storms, flooding, inland and coastal flooding, coastal storm, high tides, heavy rain, and severe storms. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. Morris County was included in 10 of these flood-related declarations.

For this 2015 Plan update, flood events were summarized from 2008 to 2014. Known flood events, including FEMA disaster declarations, which have impacted Morris County between 2008 and 2014 are identified in Appendix G. For events prior to 2008, please refer to the 2010 County HMP. Please note that not all events that have occurred in Morris County are included due to the extent of documentation and the fact that not all sources may have been identified or researched. Loss and impact information could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP Update. Please see Section 9 for detailed information regarding impacts and losses to each municipality.

Probability of Future Occurrences

Based on the historic and more recent flood events in Morris County, it is clear that the County has a high probability of flooding for the future. The fact that the elements required for flooding exist and that major flooding has occurred throughout the County in the past suggests that many people and properties are at risk



from the flood hazard in the future. It is estimated that Morris County will continue to experience direct and indirect impacts of flooding events annually that may induce secondary hazards such as coastal erosion, storm surge in coastal areas, infrastructure deterioration or failure, utility failures, power outages, water quality and supply concerns, and transportation delays, accidents and inconveniences.

As defined by FEMA, geographic areas within the 100-year floodplain in Morris County are estimated to have a one-percent chance of flooding in any given year. A structure located within a 100-year floodplain has a 26-percent chance of suffering flood damage during the term of a 30-year mortgage. Geographic areas in Morris County located within the 500-year flood boundary are estimated to have a 0.2-percent chance of being flooded in any given year (FEMA, 2003; FEMA, 2006).

In Section 5.3, the identified hazards of concern for Morris County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Committee, the probability of occurrence for drought in the County is considered ‘frequent’ (likely to occur within 25 years, as presented in Table 5.3-3).

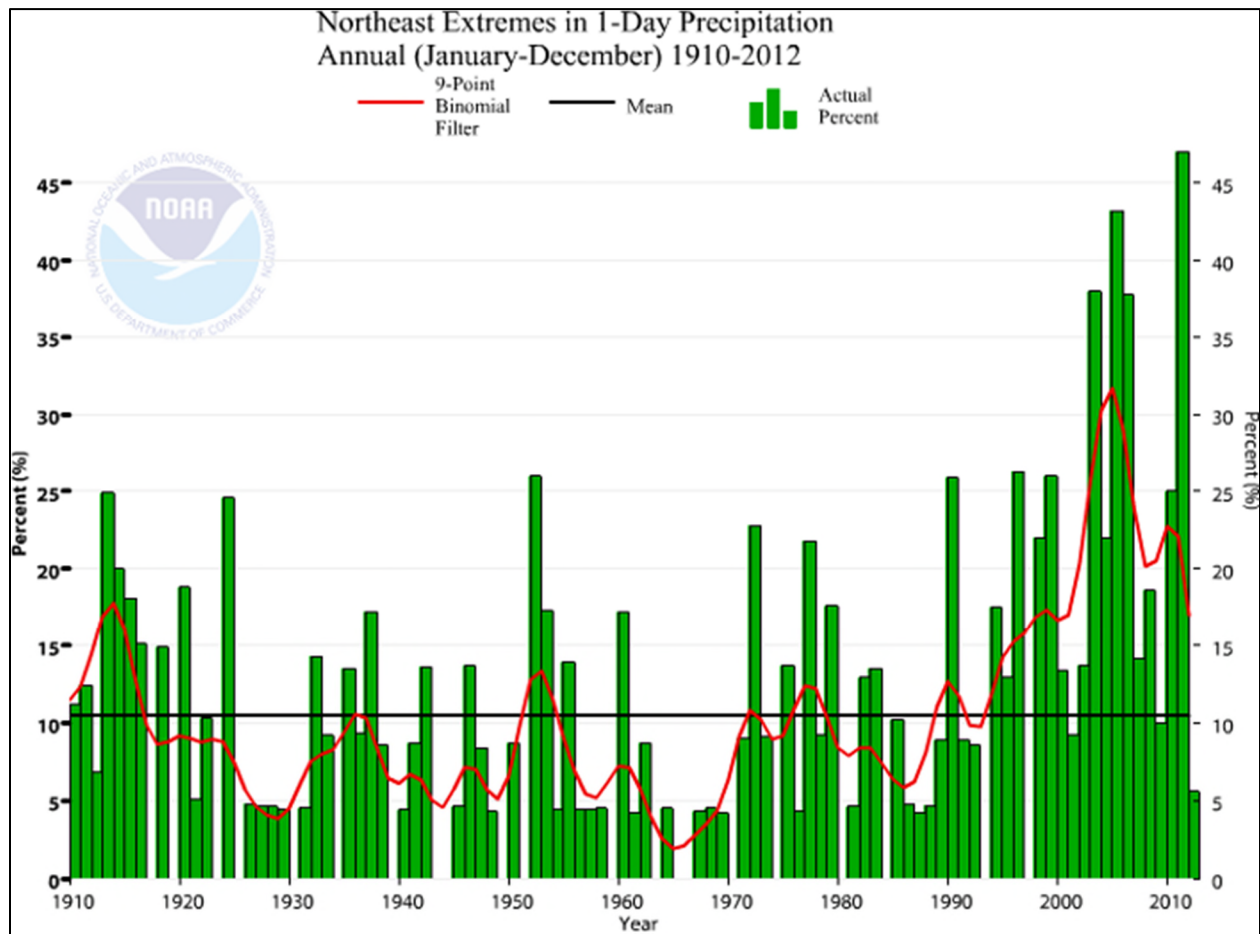
Climate Change Impacts

The climate of New Jersey is already changing and will continue to change over the course of this century. Over the long term, there has been an upward trend in annual precipitation in New Jersey and both northern and southern New Jersey have become wetter over the past century. Since 1895, annual precipitation has increased at a rate of 4.1 inches. Heavy precipitation events have increased by 71% since 1958 and it is expected that this trend may continue (Rutgers Climate Institute 2013). The maximum recorded precipitation in Morris County is 10.5 inches that occurred as a result of Tropical Storm Irene (August 27-28 2011).

Northern New Jersey’s 1971-2000 precipitation average was over five inches (12%) greater than the average from 1895-1970. Southern New Jersey became two inches (5%) wetter late in the 20th century (Office of New Jersey State Climatologist 2015). Average annual precipitation is projected to increase in the region by 5% by the 2020s and up to 10% by the 2050s. Most of the additional precipitation is expected to come during the winter months (New York City Panel on Climate Change [NPCC] 2009). Figure 5.4.5-2 shows the frequency of heavy precipitation events in the northeastern United States. With this increase in frequency of precipitation, New Jersey and Morris County may experience more flooding events. More intense, frequent flooding could lead to significant habitat loss for wildlife (State of New Jersey 2010). Future climate change may also lead to sea level rise which could lead to more frequent and extensive flooding in Morris County.



Figure 5.4.5-2. Frequency of Heavy Precipitation Events in the Northeastern United States, 1910 to 2010



Source: Rutgers Climate Institute 2013



5.4.5.2 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed and vulnerable in the identified hazard area. For the flood hazard, areas identified as hazard areas include the one-percent and 0.2-percent annual chance flood event boundaries (Figure 5.4.5-1). The following text evaluates and estimates the potential impact of flooding for Morris County including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, health and safety of residents, (2) general building stock, (3) critical facilities, (4) economy, and (5) future growth and development
- Effect of climate change on vulnerability
- Change of vulnerability as compared to that presented in the 2010 Morris County Hazard Mitigation Plan
- Further data collections that will assist understanding this hazard over time

Overview of Vulnerability

Flood is a significant concern for Morris County. To assess vulnerability, exposure to the one- and 0.2-percent annual chance flood events was examined and potential losses were calculated for one- percent annual chance flood event. The flood hazard exposure and loss estimate analysis is presented below.

Data and Methodology

The one- and 0.2-percent annual chance flood events were examined to evaluate the County's risk to the flood hazard. These flood events are generally those considered by planners and evaluated under federal programs such as the NFIP.

The one-percent annual chance flood event was examined to evaluate the County's risk and vulnerability to the flood hazard. An update to specific riverine reaches in Morris County were released in March 2015 through a FEMA preliminary DFIRM ; these updated reaches were combined with the FEMA preliminary DFIRM released in 2012 and was used to evaluate the County's exposure to this hazard.

To estimate potential losses, the Hazards U.S. Multi-Hazard (HAZUS-MH) flood model was used. The 2015 preliminary DFIRM depth grids provided by NJDEP were mosaicked with the depth grids generated by Tetra Tech for the 2014 State HMP and were incorporated into HAZUS-MH. The depth grids were integrated into HAZUS-MH and the model was run to estimate potential losses at the structure level using the County's custom structural building inventory.

The HAZUS-MH model uses 2000 U.S. Census demographic data. This data was not updated for this analysis; however, the 2010 U.S. Census data was used to estimate population exposure to provide the best available output. HAZUS-MH 2.1 calculated the estimated damages to the general building stock and critical facilities based on the custom inventories, provided depth grid and the default HAZUS damage functions in the flood model.

Impact on Life, Health and Safety

The impact of flooding on life, health and safety is dependent upon several factors including the severity of the event and whether or not adequate warning time is provided to residents. Exposure represents the population living in or near floodplain areas that could be impacted should a flood event occur. Additionally, exposure should not be limited to only those who reside in a defined hazard zone, but everyone who may be affected by the effects of a hazard event (e.g., people are at risk while traveling in flooded areas, or their access to emergency services is compromised during an event). The degree of that impact will vary and is not strictly measurable.



To estimate the population exposed to the one- and 0.2-percent flood events, the floodplain boundaries were overlaid upon the 2010 Census population data in GIS (U.S. Census 2010). The 2010 Census blocks with their centroid in the flood boundaries were used to calculate the estimated population exposed to this hazard. Within the floodplain population, senior citizens and the population in poverty are two especially vulnerable groups that must be taken under special consideration when planning for disaster preparation, response, and recovery.

Census blocks do not follow the boundaries of the floodplain and can grossly over or under estimate the population exposed when using the centroid or the intersect of the Census block with these zones. The limitations of these analyses are recognized, and as such the results are only used to provide a general estimate. The total land area located in the one-percent and 0.2-percent annual chance flood zones was calculated using the regulatory FIRM for each jurisdiction, as presented in Table 5.4.5-1.

The calculation of the 0.2-percent annual chance flood event results is cumulative in nature, as the population exposed to the one-percent flood event will also be exposed to the 0.2-percent annual chance flood event. Using this approach, it was estimated that 32,334 people are exposed to the one-percent annual chance event and 40,227 people are exposed to the 0.2-percent annual chance flood event. Refer to Table 5.4.5-2 for results by municipality.

Table 5.4.5-1. Total Land Area in the One-Percent and 0.2-Percent Annual Chance Flood Zones (Acres)

Municipality	Total Area (acres)	1% Flood Event Hazard Area		0.2% Flood Event Hazard Area	
		Area (acres)	% of Total	Area (acres)	% of Total
Town of Boonton	1,589.8	129.4	8.1%	136.8	8.6%
Township of Boonton	5,436.8	509.7	9.4%	544.9	10.0%
Borough of Butler	1,318.4	44.6	3.4%	54.1	4.1%
Chatham Borough	1,522.1	172.9	11.4%	202.0	13.3%
Chatham Township	5,984.0	2,129.0	35.6%	2,147.4	35.9%
Chester Borough	0.0	0.0	0.0%	0.0	0.0%
Chester Township	18,694.4	1,422.5	7.6%	1,457.1	7.8%
Denville Township	8,151.7	1,220.7	15.0%	1,410.6	17.3%
Town of Dover	1,745.3	217.9	12.5%	265.1	15.2%
Township of East Hanover	5,182.7	1,794.2	34.6%	2,074.8	40.0%
Borough of Florham Park	4,787.2	1,175.1	24.5%	1,368.1	28.6%
Township of Hanover	6,878.1	1,461.5	21.2%	1,572.1	22.9%
Township of Harding	13,162.2	4,537.5	34.5%	4,608.1	35.0%
Township of Jefferson	27,393.9	2,767.2	10.1%	2,977.2	10.9%
Borough of Kinnelon	12,309.1	71.7	0.6%	74.4	0.6%
Borough of Lincoln Park	4,426.9	2,819.9	63.7%	2,991.3	67.6%
Township of Long Hill	7,713.9	4,230.8	54.8%	4,434.6	57.5%
Borough of Madison	2,764.8	29.9	1.1%	43.2	1.6%
Borough of Mendham	3,826.6	94.0	2.5%	97.2	2.5%

**Table 5.4.5-1. Total Land Area in the One-Percent and 0.2-Percent Annual Chance Flood Zones (Acres)**

Municipality	Total Area (acres)	1% Flood Event Hazard Area		0.2% Flood Event Hazard Area	
		Area (acres)	% of Total	Area (acres)	% of Total
Township of Mendham	11,527.0	503.1	4.4%	557.5	4.8%
Township of Mine Hill	1,916.2	38.3	2.0%	38.6	2.0%
Township of Montville	12,231.7	2,249.1	18.4%	2,610.7	21.3%
Borough of Morris Plains	1,657.0	133.2	8.0%	148.9	9.0%
Township of Morris	10,118.4	708.6	7.0%	756.0	7.5%
Town of Morristown	1,923.8	91.1	4.7%	106.0	5.5%
Borough of Mount Arlington	1,794.6	399.8	22.3%	404.3	22.5%
Township of Mount Olive	19,991.7	1,826.2	9.1%	1,983.2	9.9%
Borough of Mountain Lakes	0.0	0.0	0.0%	0.0	0.0%
Netcong Borough	611.8	79.1	12.9%	79.7	13.0%
Township of Parsippany-Troy Hills	16,223.4	3,512.4	21.7%	4,119.0	25.4%
Township of Pequannock	4,548.5	1,570.9	34.5%	1,763.3	38.8%
Township of Randolph	13,541.7	602.9	4.5%	679.9	5.0%
Borough of Riverdale	1,323.5	124.8	9.4%	166.1	12.5%
Borough of Rockaway	1,356.8	244.6	18.0%	297.1	21.9%
Township of Rockaway	29,366.7	1,312.1	4.5%	1,398.0	4.8%
Township of Roxbury	14,033.9	1,041.0	7.4%	1,194.5	8.5%
Borough of Victory Gardens	92.8	1.5	1.7%	5.0	5.4%
Township of Washington	28,726.4	1,324.2	4.6%	1,442.0	5.0%
Borough of Wharton	1,365.1	102.2	7.5%	128.8	9.4%
Morris County (Total)	305,238.8	40,693.6	13.3%	44,337.4	14.5%

Source: FEMA 2012, 2015

Note: % = Percent;

The area presented includes the area of inland waterways



Table 5.4.5-2. Estimated Population Exposed to the Flood Hazard

Municipality	Total Population	One-Percent Chance Event		0.2-Percent Chance Event	
		Total Number	% of Total	Total Number	% of Total
Town of Boonton	8,347	9	<1%	9	<1%
Township of Boonton	4,263	207	4.9%	229	5.4%
Borough of Butler	7,539	84	1.1%	84	1.1%
Chatham Borough	8,962	147	1.6%	175	2.0%
Chatham Township	10,452	1,112	10.6%	1,150	11.0%
Chester Borough	1,649	0	0.0%	0	0.0%
Chester Township	7,838	64	<1%	80	1.0%
Denville Township	16,635	2,182	13.1%	2,731	16.4%
Town of Dover	18,157	2,745	15.1%	3,536	19.5%
Township of East Hanover	11,157	1,418	12.7%	1,752	15.7%
Borough of Florham Park	11,696	2,068	17.7%	2,115	18.1%
Township of Hanover	13,712	942	6.9%	963	7.0%
Township of Harding	3,838	305	7.9%	356	9.3%
Township of Jefferson	21,314	1,187	5.6%	1,232	5.8%
Borough of Kinnelon	10,248	0	0.0%	0	0.0%
Borough of Lincoln Park	10,521	5,226	49.7%	5,492	52.2%
Township of Long Hill	8,702	1,519	17.5%	1,975	22.7%
Borough of Madison	15,845	0	0.0%	0	0.0%
Borough of Mendham	4,981	0	0.0%	0	0.0%
Township of Mendham	5,869	6	<1%	6	<1%
Township of Mine Hill	3,651	0	0.0%	0	0.0%
Township of Montville	21,528	1,779	8.3%	2,400	11.1%
Borough of Morris Plains	5,532	118	2.1%	118	2.1%
Township of Morris	22,306	391	1.8%	919	4.1%
Town of Morristown	18,411	759	4.1%	768	4.2%
Borough of Mount Arlington	5,050	0	0.0%	0	0.0%
Township of Mount Olive	28,117	576	2.0%	726	2.6%
Borough of Mountain Lakes	4,160	0	0.0%	0	0.0%
Netcong Borough	3,232	0	0.0%	0	0.0%
Township of Parsippany-Troy Hills	53,238	3,165	5.9%	6,057	11.4%



Table 5.4.5-2. Estimated Population Exposed to the Flood Hazard

Municipality	Total Population	One-Percent Chance Event		0.2-Percent Chance Event	
		Total Number	% of Total	Total Number	% of Total
Township of Pequannock	15,540	2,943	18.9%	3,558	22.9%
Township of Randolph	25,736	242	<1%	327	1.3%
Borough of Riverdale	3,559	244	6.9%	293	8.2%
Borough of Rockaway	6,438	291	4.5%	360	5.6%
Township of Rockaway	24,156	923	3.8%	942	3.9%
Township of Roxbury	23,324	1,411	6.0%	1,495	6.4%
Borough of Victory Gardens	1,520	0	0.0%	61	4.0%
Township of Washington	18,533	206	1.1%	206	1.1%
Borough of Wharton	6,522	65	1.0%	112	1.7%
Morris County (Total)	492,276	32,334	6.6%	40,227	8.2%

Sources: U.S. Census 2010; FEMA, 2012, 2015

Note:



The table above shows that approximately 6.6-percent of the total population is exposed to the one-percent annual chance flood event and that approximately 8.2 percent of the total population is exposed to the 0.2-percent annual chance flood event. Lincoln Park has the greatest total population located in the floodplain; approximately 49.7% and 52.2% for the one-percent chance event and 0.2-percent chance event, respectively. For this project, the potential population exposed is used as a guide for planning purposes.

Of the population exposed, the most vulnerable include the economically disadvantaged and the population over the age of 65. Economically disadvantaged populations are more vulnerable because they are likely to evaluate their risk and make decisions to evacuate based on the net economic impact to their family. The population over the age of 65 is also more vulnerable because they are more likely to seek or need medical attention which may not be available to due isolation during a flood event and they may have more difficulty evacuating. Special consideration should be taken when planning for disaster preparation, response, and recovery for these vulnerable groups.

Using 2000 U.S. Census data, HAZUS-MH 2.1 estimates the potential sheltering needs as a result of a one-percent chance flood event. For the one-percent flood event, HAZUS-MH 2.1 estimates 33,446 households will be displaced and 26,403 people will seek short-term sheltering. These statistics, by municipality, are presented in Table 5.4.5-3.

Table 5.4.5-3. Estimated Population Displaced or Seeking Short-Term Shelter from the one-percent Annual Chance Flood Event

Municipality	U.S. Census 2010 Population	One-Percent Annual Chance Event	
		Displaced Households	Persons Seeking Short-Term Sheltering
Town of Boonton	8,347	136	86
Township of Boonton	4,263	342	181
Borough of Butler	7,539	298	168
Chatham Borough	8,962	169	124
Chatham Township	10,452	1,174	1,118
Chester Borough	1,649	0	0
Chester Township	7,838	284	84
Denville Township	16,635	2,074	1,522
Town of Dover	18,157	3,001	2,716
Township of East Hanover	11,157	2,140	2,010
Borough of Florham Park	11,696	537	426
Township of Hanover	13,712	580	447
Township of Harding	3,838	278	128
Township of Jefferson	21,314	1,119	600
Borough of Kinnelon	10,248	0	0
Borough of Lincoln Park	10,521	5,465	4,919
Township of Long Hill	8,702	1,679	1,432
Borough of Madison	15,845	101	91
Borough of Mendham	4,981	89	26

**Table 5.4.5-3. Estimated Population Displaced or Seeking Short-Term Shelter from the one-percent Annual Chance Flood Event**

Municipality	U.S. Census 2010 Population	One-Percent Annual Chance Event	
		Displaced Households	Persons Seeking Short-Term Sheltering
Township of Mendham	5,869	245	73
Township of Mine Hill	3,651	35	27
Township of Montville	21,528	1,470	958
Borough of Morris Plains	5,532	202	115
Township of Morris	22,306	693	370
Town of Morristown	18,411	298	205
Borough of Mount Arlington	5,050	41	11
Township of Mount Olive	28,117	1,207	949
Borough of Mountain Lakes	4,160	0	0
Netcong Borough	3,232	21	5
Township of Parsippany-Troy Hills	53,238	2,415	1,901
Township of Pequannock	15,540	3,493	3,152
Township of Randolph	25,736	611	385
Borough of Riverdale	3,559	260	224
Borough of Rockaway	6,438	243	125
Township of Rockaway	24,156	629	320
Township of Roxbury	23,324	1,426	1,168
Borough of Victory Gardens	1,520	15	4
Township of Washington	18,533	558	265
Borough of Wharton	6,522	118	68
Morris County (Total)	492,276	33,446	26,403

Source: HAZUS-MH

The total number of injuries and casualties resulting from flooding is generally limited based on advance weather forecasting, blockades and warnings. Therefore, injuries and deaths generally are not anticipated if proper warning and precautions are in place. Ongoing mitigation efforts should help to avoid the most likely cause of injury, which results from persons trying to cross flooded roadways or channels during a flood.

Impact on General Building Stock

After considering the population exposed and vulnerable to the flood hazard, the built environment was evaluated. Exposure includes those buildings located in the flood zone. Potential damage is the modeled loss that could occur to the exposed inventory, including structural and content value.

To provide a general estimate of the structural/content replacement value exposure, the one- and 0.2-percent DFIRM flood boundaries were overlaid upon the County's updated building stock inventory at the structure level. The buildings with their centroid in the hazard areas were totaled for each municipality. Table 5.4.5-4 and Table 5.4.5-5 summarize these results. In summary, there are 5,158 buildings located in one-percent annual



chance flood boundary with an estimated \$4.6 billion of building/contents exposed (based on estimated replacement cost value). In total, this represents approximately 3.0% of the County’s total general building stock inventory (approximately \$155 billion).

There are 8,405 buildings located in the 0.2-percent annual chance flood boundary with an estimated \$8 billion of building/contents exposed. This represents approximately 5.1% of the County’s total general building stock inventory.

Table 5.4.5-4. Estimated General Building Stock Exposure to the One- Percent Annual Chance Flood Event – All Occupancies

Municipality	Total # Buildings	Total Replacement Value (Structure and Contents)	Total (All Occupancies)			
			# Buildings	% Total	Total Replacement Value (Structure and Contents)	% Total
Town of Boonton	3,210	\$2,359,806,704	0	0.0%	\$0	0.0%
Township of Boonton	1,853	\$1,657,854,494	26	1.4%	\$15,248,384	<1%
Borough of Butler	2,725	\$1,818,159,072	34	1.2%	\$18,950,313	1.0%
Chatham Borough	3,245	\$2,112,769,732	21	<1%	\$32,049,402	1.5%
Chatham Township	3,998	\$3,234,872,840	27	<1%	\$8,937,967	<1%
Chester Borough	859	\$798,032,736	0	0.0%	\$0	0.0%
Chester Township	3,587	\$3,763,335,644	7	<1%	\$4,567,805	<1%
Denville Township	7,032	\$5,687,212,965	499	7.1%	\$330,481,778	5.8%
Town of Dover	4,385	\$3,075,745,326	460	10.5%	\$419,996,479	13.7%
Township of East Hanover	4,776	\$5,401,896,233	180	3.8%	\$169,989,678	3.1%
Borough of Florham Park	3,722	\$3,991,843,257	48	1.3%	\$93,287,715	2.3%
Township of Hanover	7,045	\$6,582,774,313	113	1.6%	\$334,134,123	5.1%
Township of Harding	2,050	\$2,344,644,664	82	4.0%	\$55,038,001	2.3%
Township of Jefferson	9,281	\$5,074,333,318	102	1.1%	\$32,279,876	<1%
Borough of Kinnelon	4,078	\$3,942,612,191	2	<1%	\$3,309,451	<1%
Borough of Lincoln Park	4,184	\$2,521,331,492	924	22.1%	\$700,221,439	27.8%
Township of Long Hill	3,515	\$2,686,329,094	287	8.2%	\$235,426,609	8.8%
Borough of Madison	6,235	\$4,038,218,735	1	<1%	\$33,586	<1%
Borough of Mendham	2,054	\$1,938,234,052	6	<1%	\$4,406,090	<1%
Township of Mendham	2,545	\$2,900,551,737	28	1.1%	\$12,424,990	<1%
Township of Mine Hill	1,555	\$968,302,365	1	<1%	\$795,760	<1%
Township of Montville	8,066	\$7,935,508,932	240	3.0%	\$418,594,926	5.3%
Borough of Morris Plains	2,361	\$2,353,504,441	11	<1%	\$150,398,274	6.4%
Township of Morris	9,488	\$8,423,230,635	49	<1%	\$25,109,642	<1%
Town of Morristown	4,935	\$4,131,251,475	9	<1%	\$3,627,046	<1%
Borough of Mount Arlington	2,303	\$1,698,506,114	3	<1%	\$1,123,135	<1%
Township of Mount Olive	8,525	\$7,726,519,709	120	1.4%	\$77,842,654	1.0%
Borough of Mountain Lakes	1,589	\$1,470,833,586	0	0.0%	\$0	0.0%
Netcong Borough	1,075	\$936,477,404	1	<1%	\$168,801	<1%
Township of Parsippany-Troy Hills	17,033	\$14,262,637,338	521	3.1%	\$166,685,775	1.2%
Township of Pequannock	5,586	\$4,903,988,440	962	17.2%	\$997,643,863	20.3%

**Table 5.4.5-4. Estimated General Building Stock Exposure to the One- Percent Annual Chance Flood Event – All Occupancies**

Municipality	Total # Buildings	Total Replacement Value (Structure and Contents)	Total (All Occupancies)			
			# Buildings	% Total	Total Replacement Value (Structure and Contents)	% Total
Township of Randolph	8,375	\$8,283,021,151	33	<1%	\$40,923,476	<1%
Borough of Riverdale	1,155	\$1,246,580,332	92	8.0%	\$70,695,558	5.7%
Borough of Rockaway	2,580	\$1,804,154,071	66	2.6%	\$70,417,652	3.9%
Township of Rockaway	11,215	\$7,782,228,135	76	<1%	\$67,904,499	<1%
Township of Roxbury	9,408	\$6,601,093,651	25	<1%	\$8,591,927	<1%
Borough of Victory Gardens	338	\$138,840,857	0	0.0%	\$0	0.0%
Township of Washington	7,793	\$6,580,308,267	97	1.2%	\$60,473,655	<1%
Borough of Wharton	2,040	\$1,699,397,922	5	<1%	\$16,086,523	<1%
Morris County (Total)	185,799	\$154,876,943,422	5,158	2.8%	\$4,647,866,853	3.0%

Source: FEMA 2012, 2015, Morris County

Table 5.4.5-5. Estimated General Building Stock Exposure to the 0.2-Percent Annual Chance Flood Event – All Occupancies

Municipality	Total # Buildings	Total Replacement Value	Total (All Occupancies) 0.2-Percent			
			# Buildings	% Total	Total Replacement Value (Structure and Contents)	% Total
Town of Boonton	3,210	\$2,359,806,704	4	0.1%	\$1,181,127	0.1%
Township of Boonton	1,853	\$1,657,854,494	43	2.3%	\$21,726,274	1.3%
Borough of Butler	2,725	\$1,818,159,072	49	1.8%	\$34,691,119	1.9%
Chatham Borough	3,245	\$2,112,769,732	52	1.6%	\$50,934,817	2.4%
Chatham Township	3,998	\$3,234,872,840	27	0.7%	\$8,937,967	0.3%
Chester Borough	859	\$798,032,736	0	0.0%	\$0	0.0%
Chester Township	3,587	\$3,763,335,644	9	0.3%	\$5,769,366	0.2%
Denville Township	7,032	\$5,687,212,965	763	10.9%	\$493,868,610	8.7%
Town of Dover	4,385	\$3,075,745,326	652	14.9%	\$561,319,752	18.2%
Township of East Hanover	4,776	\$5,401,896,233	535	11.2%	\$584,314,475	10.8%
Borough of Florham Park	3,722	\$3,991,843,257	85	2.3%	\$138,909,693	3.5%
Township of Hanover	7,045	\$6,582,774,313	133	1.9%	\$372,550,499	5.7%
Township of Harding	2,050	\$2,344,644,664	92	4.5%	\$68,510,136	2.9%
Township of Jefferson	9,281	\$5,074,333,318	204	2.2%	\$90,676,035	1.8%
Borough of Kinnelon	4,078	\$3,942,612,191	2	0.0%	\$3,309,451	0.1%
Borough of Lincoln Park	4,184	\$2,521,331,492	1,160	27.7%	\$855,205,550	33.9%
Township of Long Hill	3,515	\$2,686,329,094	543	15.4%	\$478,324,586	17.8%
Borough of Madison	6,235	\$4,038,218,735	49	0.8%	\$20,053,466	0.5%
Borough of Mendham	2,054	\$1,938,234,052	8	0.4%	\$5,639,328	0.3%
Township of Mendham	2,545	\$2,900,551,737	36	1.4%	\$18,946,374	0.7%
Township of Mine Hill	1,555	\$968,302,365	1	0.1%	\$795,760	0.1%
Township of Montville	8,066	\$7,935,508,932	512	6.3%	\$1,142,835,324	14.4%
Borough of Morris Plains	2,361	\$2,353,504,441	15	0.6%	\$152,422,752	6.5%

**Table 5.4.5-5. Estimated General Building Stock Exposure to the 0.2-Percent Annual Chance Flood Event – All Occupancies**

Municipality	Total # Buildings	Total Replacement Value	Total (All Occupancies) 0.2-Percent			
			# Buildings	% Total	Total Replacement Value (Structure and Contents)	% Total
Township of Morris	9,488	\$8,423,230,635	68	0.7%	\$39,155,374	0.5%
Town of Morristown	4,935	\$4,131,251,475	26	0.5%	\$21,416,882	0.5%
Borough of Mount Arlington	2,303	\$1,698,506,114	6	0.3%	\$3,211,099	0.2%
Township of Mount Olive	8,525	\$7,726,519,709	155	1.8%	\$96,722,860	1.3%
Borough of Mountain Lakes	1,589	\$1,470,833,586	0	0.0%	\$0	0.0%
Netcong Borough	1,075	\$936,477,404	1	0.1%	\$168,801	0.0%
Township of Parsippany-Troy Hills	17,033	\$14,262,637,338	1,111	6.5%	\$661,584,152	4.6%
Township of Pequannock	5,586	\$4,903,988,440	1,195	21.4%	\$1,245,632,067	25.4%
Township of Randolph	8,375	\$8,283,021,151	44	0.5%	\$129,150,831	1.6%
Borough of Riverdale	1,155	\$1,246,580,332	138	11.9%	\$178,038,805	14.3%
Borough of Rockaway	2,580	\$1,804,154,071	133	5.2%	\$134,957,129	7.5%
Township of Rockaway	11,215	\$7,782,228,135	116	1.0%	\$133,945,015	1.7%
Township of Roxbury	9,408	\$6,601,093,651	279	3.0%	\$75,701,096	1.1%
Borough of Victory Gardens	338	\$138,840,857	11	3.3%	\$12,286,807	8.8%
Township of Washington	7,793	\$6,580,308,267	135	1.7%	\$91,105,012	1.4%
Borough of Wharton	2,040	\$1,699,397,922	13	0.6%	\$28,796,189	1.7%
Morris County (Total)	185,799	\$154,876,943,422	8,405	4.5%	\$7,962,794,578	5.1%

Source: FEMA 2012, 2015, Morris County

The HAZUS-MH flood model estimated potential damages to the buildings in Morris County at the structure level using the custom County structure inventory developed for this plan. The potential damage estimated by HAZUS-MH to the general building stock inventory associated with the one-percent annual chance flood is approximately \$572 million or less than one-percent of the total building stock replacement cost value. The potential damage estimated by HAZUS-MH to the residential general building stock inventory associated with the one-percent annual chance flood is \$237 million or less than 1-percent of the total building stock replacement cost value.



Table 5.4.5-6. Estimated General Building Stock Potential Loss to the one-percent Annual Chance Flood Event

Municipality	Total Replacement Cost Value	1% Annual Chance Event							
		All Occupancies		Residential		Commercial		Industrial, Religious, Education and Government	
		Estimated Loss	% of Total	Estimated Loss	% of Total	Estimated Loss	% of Total	Estimated Loss	% of Total
Town of Boonton	\$2,359,806,704	\$2,076,829	<1%	\$1,445,020	<1%	\$197,237	<1%	\$434,573	<1%
Township of Boonton	\$1,657,854,494	\$0	0.0%	\$0	0.0%	\$0	0.0%	\$0	0.0%
Borough of Butler	\$1,818,159,072	\$3,197,862	<1%	\$691,110	<1%	\$553,816	<1%	\$1,952,937	<1%
Chatham Borough	\$2,112,769,732	\$1,750,554	<1%	\$151,759	<1%	\$1,546,680	<1%	\$52,115	<1%
Chatham Township	\$3,234,872,840	\$289,120	<1%	\$289,120	<1%	\$0	0.0%	\$0	0.0%
Chester Borough	\$798,032,736	\$0	0.0%	\$0	0.0%	\$0	0.0%	\$0	0.0%
Chester Township	\$3,763,335,644	\$835,109	<1%	\$62,314	<1%	\$0	0.0%	\$772,795	<1%
Denville Township	\$5,687,212,965	\$51,047,162	<1%	\$27,981,851	<1%	\$19,540,252	<1%	\$3,525,060	<1%
Town of Dover	\$3,075,745,326	\$34,416,844	1.1%	\$13,814,490	<1%	\$10,889,315	<1%	\$9,713,039	<1%
Township of East Hanover	\$5,401,896,233	\$5,664,478	<1%	\$4,164,164	<1%	\$598,075	<1%	\$902,239	<1%
Borough of Florham Park	\$3,991,843,257	\$7,394,717	<1%	\$1,468,648	<1%	\$5,339,268	<1%	\$586,800	<1%
Township of Hanover	\$6,582,774,313	\$21,518,678	<1%	\$1,597,762	<1%	\$9,087,660	<1%	\$10,833,256	<1%
Township of Harding	\$2,344,644,664	\$2,715,094	<1%	\$2,261,808	<1%	\$100,693	<1%	\$352,593	<1%
Township of Jefferson	\$5,074,333,318	\$4,058,481	<1%	\$3,694,557	<1%	\$18,321	<1%	\$345,602	<1%
Borough of Kinnelon	\$3,942,612,191	\$0	0.0%	\$0	0.0%	\$0	0.0%	\$0	0.0%
Borough of Lincoln Park	\$2,521,331,492	\$181,279,791	7.2%	\$96,477,551	3.8%	\$7,142,264	<1%	\$77,659,723	3.1%
Township of Long Hill	\$2,686,329,094	\$5,971,436	<1%	\$2,851,323	<1%	\$969,828	<1%	\$2,150,284	<1%
Borough of Madison	\$4,038,218,735	\$6,738	<1%	\$6,738	<1%	\$0	0.0%	\$0	0.0%
Borough of Mendham	\$1,938,234,052	\$306,511	<1%	\$50,858	<1%	\$0	0.0%	\$255,653	<1%
Township of Mendham	\$2,900,551,737	\$866,616	<1%	\$517,310	<1%	\$663	<1%	\$348,642	<1%
Township of Mine Hill	\$968,302,365	\$60,526	<1%	\$0	0.0%	\$0	0.0%	\$60,526	<1%
Township of Montville	\$7,935,508,932	\$9,997,730	<1%	\$2,875,765	<1%	\$4,090,949	<1%	\$3,031,017	<1%
Borough of Morris Plains	\$2,353,504,441	\$6,111,643	<1%	\$104,296	<1%	\$0	0.0%	\$6,007,346	<1%
Township of Morris	\$8,423,230,635	\$749,670	<1%	\$272,084	<1%	\$0	0.0%	\$477,586	<1%
Town of Morristown	\$4,131,251,475	\$357,793	<1%	\$283,809	<1%	\$35,601	<1%	\$38,383	<1%



Table 5.4.5-6. Estimated General Building Stock Potential Loss to the one-percent Annual Chance Flood Event

Municipality	Total Replacement Cost Value	1% Annual Chance Event							
		All Occupancies		Residential		Commercial		Industrial, Religious, Education and Government	
		Estimated Loss	% of Total	Estimated Loss	% of Total	Estimated Loss	% of Total	Estimated Loss	% of Total
Borough of Mount Arlington	\$1,698,506,114	\$16,970	<1%	\$0	0.0%	\$16,970	<1%	\$0	0.0%
Township of Mount Olive	\$7,726,519,709	\$2,776,201	<1%	\$2,247,275	<1%	\$38,341	<1%	\$490,585	<1%
Borough of Mountain Lakes	\$1,470,833,586	\$0	0.0%	\$0	0.0%	\$0	0.0%	\$0	0.0%
Netcong Borough	\$936,477,404	\$162,822	<1%	\$93,848	<1%	\$0	0.0%	\$68,974	<1%
Township of Parsippany-Troy Hills	\$14,262,637,338	\$16,592,212	<1%	\$11,592,336	<1%	\$2,485,449	<1%	\$2,514,427	<1%
Township of Pequannock	\$4,903,988,440	\$185,163,191	3.8%	\$53,986,276	1.1%	\$49,005,881	<1%	\$82,171,033	1.7%
Township of Randolph	\$8,283,021,151	\$1,781,516	<1%	\$1,012,076	<1%	\$0	0.0%	\$769,440	<1%
Borough of Riverdale	\$1,246,580,332	\$2,599,977	<1%	\$2,310,866	<1%	\$272,672	<1%	\$16,438	<1%
Borough of Rockaway	\$1,804,154,071	\$7,107,239	<1%	\$472,578	<1%	\$1,179,566	<1%	\$5,455,095	<1%
Township of Rockaway	\$7,782,228,135	\$6,246,737	<1%	\$617,913	<1%	\$3,708,062	<1%	\$1,920,763	<1%
Township of Roxbury	\$6,601,093,651	\$101,022	<1%	\$91,467	<1%	\$9,554	<1%	\$0	0.0%
Borough of Victory Gardens	\$138,840,857	\$0	0.0%	\$0	0.0%	\$0	0.0%	\$0	0.0%
Township of Washington	\$6,580,308,267	\$4,925,509	<1%	\$3,500,810	<1%	\$865,538	<1%	\$559,161	<1%
Borough of Wharton	\$1,699,397,922	\$3,476,126	<1%	\$0	0.0%	\$453,593	<1%	\$3,022,534	<1%
Morris County (Total)	\$154,876,943,422	\$571,622,902	<1%	\$236,987,782	<1%	\$118,146,248	<1%	\$216,488,619	<1%

Source: HAZUS-MH, Morris County



NFIP Statistics

In addition to total building stock modeling, individual data available on flood policies, claims, Repetitive Loss Properties (RLP) and severe RLP (SRLs) were analyzed. FEMA Region 2 provided a list of residential properties with NFIP policies, past claims and multiple claims (RLPs). According to the metadata provided: “The (*sic* National Flood Insurance Program) NFIP Repetitive Loss File contains losses reported from individuals who have flood insurance through the Federal Government. A property is considered a repetitive loss property when there are two or more losses reported which were paid more than \$1,000 for each loss. The two losses must be within 10 years of each other & be at least 10 days apart. Only losses from (*sic* since) 1/1/1978 that are closed are considered.”

SRLs were then examined for the County. According to section 1361A of the National Flood Insurance Act, as amended (NFIA), 42 U.S.C. 4102a, an SRL property is defined as a residential property that is covered under an NFIP flood insurance policy and:

- Has at least four NFIP claim payments (including building and contents) over \$5,000 each, and the cumulative amount of such claims payments exceeds \$20,000; or
- For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.
- For both of the above, at least two of the referenced claims must have occurred within any 10- year period, and must be greater than 10 days apart.

Table 5.4.5-7 through Table 5.4.5-9 summarize the NFIP policies, claims and repetitive loss statistics for Morris County. According to FEMA, Table 5.4.5-9 summarizes the occupancy classes of the repetitive loss and severe repetitive loss properties in Morris County. The majority of the repetitive loss occupancy class is single family residences (86.1%). The majority of severe repetitive loss occupancy class is also single family residences (82.7%) (FEMA Region 2, 2014). This information is current as of September 30th, 2014.

The location of the properties with policies, claims and repetitive and severe repetitive flooding were geocoded by FEMA with the understanding that there are varying tolerances between how closely the longitude and latitude coordinates correspond to the location of the property address, or that the indication of some locations are more accurate than others.

Table 5.4.5-7. Occupancy Class of Repetitive Loss Structures in Morris County

Occupancy Class	Total Number of Repetitive Loss Properties	Total Number of Severe Repetitive Loss Properties	Total (RL + SRL)
Single Family	447	234	681
Condo	15	18	33
2-4 Family	16	7	23
Other Residential	1	0	1
Non-Residential	40	24	64
Morris County	519	283	802

Source: FEMA Region 2 2014

Note (1): Policies, claims, repetitive loss and severe repetitive loss statistics provided by FEMA Region 2, and are current as of 9/30/2014.

RL Repetitive Loss

SRL Severe Repetitive Loss



Table 5.4.5-8. Occupancy Class of Repetitive Loss Structures in Morris County, by Municipality

Municipality	Repetitive Loss Properties					Severe Repetitive Loss Properties				
	2-4 Family	Assumed Condo	Non Residential	Other Residential	Single Family	2-4 Family	Assumed Condo	Non Residential	Other Residential	Single Family
Town of Boonton	0	0	0	0	0	0	0	0	0	0
Township of Boonton	0	1	0	0	1	0	0	0	0	1
Borough of Butler	0	0	4	0	1	0	0	0	0	0
Chatham Borough	0	0	0	0	0	0	0	0	0	0
Chatham Township	0	0	0	0	1	0	0	0	0	0
Chester Borough	0	0	0	0	0	0	0	0	0	0
Chester Township	0	0	0	0	0	0	0	0	0	0
Denville Township	2	3	4	0	38	0	0	1	0	22
Town of Dover	9	4	3	1	6	2	2	11	0	1
Township of East Hanover	0	0	2	0	5	0	0	0	0	1
Borough of Florham Park	0	0	0	0	0	0	0	0	0	0
Township of Hanover	0	4	1	0	0	0	0	0	0	0
Township of Harding	0	0	0	0	0	0	0	0	0	0
Township of Jefferson	0	0	0	0	5	0	0	0	0	0
Borough of Kinnelon	0	0	0	0	0	0	0	0	0	0
Borough of Lincoln Park	3	0	5	0	124	2	16	3	0	108
Township of Long Hill	1	0	6	0	10	0	0	0	0	4
Borough of Madison	0	0	0	0	0	0	0	0	0	0
Borough of Mendham	0	0	0	0	0	0	0	0	0	0
Township of Mendham	0	0	0	0	1	0	0	0	0	0
Township of Mine Hill	0	0	0	0	0	0	0	0	0	0
Township of Montville	0	0	0	0	1	0	0	0	0	0
Borough of Morris Plains	0	0	0	0	0	0	0	0	0	0
Township of Morris	0	0	0	0	1	1	0	0	0	0
Town of Morristown	0	0	0	0	0	0	0	0	0	0
Borough of Mount Arlington	0	0	0	0	0	0	0	0	0	0
Township of Mount Olive	0	0	0	0	2	0	0	0	0	0



Table 5.4.5-8. Occupancy Class of Repetitive Loss Structures in Morris County, by Municipality

Municipality	Repetitive Loss Properties					Severe Repetitive Loss Properties				
	2-4 Family	Assumed Condo	Non Residential	Other Residential	Single Family	2-4 Family	Assumed Condo	Non Residential	Other Residential	Single Family
Borough of Mountain Lakes	0	0	0	0	0	0	0	0	0	0
Netcong Borough	0	0	0	0	0	0	0	0	0	0
Township of Parsippany-Troy Hills	0	0	0	0	25	0	0	0	0	4
Township of Pequannock	1	0	12	0	193	2	0	6	0	90
Township of Randolph	0	0	0	0	1	0	0	0	0	0
Borough of Riverdale	0	0	0	0	20	0	0	0	0	0
Borough of Rockaway	0	0	1	0	4	0	0	3	0	0
Township of Rockaway	0	0	1	0	1	0	0	0	0	0
Township of Roxbury	0	0	0	0	0	0	0	0	0	0
Borough of Victory Gardens	0	0	0	0	0	0	0	0	0	0
Township of Washington	0	3	1	0	7	0	0	0	0	2
Borough of Wharton	0	0	0	0	0	0	0	0	0	1
Morris County (Total)	16	15	40	1	447	7	18	24	0	234

Source: FEMA, 2014

Note (1): Policies, claims, repetitive loss and severe repetitive loss statistics provided by FEMA Region 2, and are current as of 9/30/2014

Note (2): The statistics were summarized using the Community Name provided by FEMA Region 2.



Table 5.4.5-9. NFIP Policies, Claims and Repetitive Loss Statistics

Municipality	# Policies (1)	# Claims (Losses) (1)	Total Loss Payments (2)	# Rep. Loss Prop. (1)	# Severe Rep. Loss Prop. (1)	# Policies in the 1% Flood Boundary (3)
Town of Boonton	9	9	\$25,875.64	0	0	2
Township of Boonton	28	43	\$1,054,845.89	2	1	13
Borough of Butler	42	27	\$330,072.87	5	0	13
Chatham Borough	51	3	\$2,753.12	0	0	7
Chatham Township	51	13	\$104,523.09	1	0	1
Chester Borough	0	0	\$0.00	0	0	0
Chester Township	15	0	\$0.00	0	0	0
Denville Township	403	713	\$17,804,481.16	47	23	303
Town of Dover	248	490	\$6,704,215.99	23	16	193
Township of East Hanover	184	80	\$1,637,773.87	7	1	103
Borough of Florham Park	77	3	\$3,795.37	0	0	26
Township of Hanover	65	63	\$3,478,082.28	5	0	18
Township of Harding	48	14	\$240,098.22	0	0	14
Township of Jefferson	147	71	\$1,163,813.74	5	0	18
Borough of Kinnelon	0	0	\$0.00	0	0	0
Borough of Lincoln Park	764	2,845	\$62,483,351.73	132	129	711
Township of Long Hill	168	123	\$2,781,215.89	17	4	96
Borough of Madison	38	3	\$3,953.48	0	0	0
Borough of Mendham	13	1	\$31,376.78	0	0	1
Township of Mendham	36	21	\$179,747.84	1	0	6
Township of Mine Hill	7	1	\$0.00	0	0	1
Township of Montville	243	94	\$3,160,460.68	1	0	85
Borough of Morris Plains	29	13	\$107,492.77	0	0	8
Township of Morris	97	50	\$822,534.96	1	1	10
Town of Morristown	53	12	\$618,195.20	0	0	4
Borough of Mount Arlington	15	2	\$3,807.33	0	0	0



Table 5.4.5-9. NFIP Policies, Claims and Repetitive Loss Statistics

Municipality	# Policies (1)	# Claims (Losses) (1)	Total Loss Payments (2)	# Rep. Loss Prop. (1)	# Severe Rep. Loss Prop. (1)	# Policies in the 1% Flood Boundary (3)
Township of Mount Olive	111	43	\$658,052.54	2	0	51
Borough of Mountain Lakes	0	0	\$0.00	0	0	0
Netcong Borough	3	3	\$1,017,297.07	0	0	0
Township of Parsippany-Troy Hills	426	518	\$13,338,444.89	25	4	250
Township of Pequannock	770	1,990	\$65,928,349.72	206	98	679
Township of Randolph	72	17	\$200,540.32	1	0	15
Borough of Riverdale	74	101	\$865,564.59	20	0	51
Borough of Rockaway	48	69	\$1,441,107.11	5	3	17
Township of Rockaway	61	51	\$508,480.07	2	0	11
Township of Roxbury	67	18	\$89,403.06	0	0	4
Borough of Victory Gardens	0	0	\$0.00	0	0	0
Township of Washington	74	77	\$1,876,494.40	11	2	33
Borough of Wharton	10	5	\$77,647.54	0	1	1
Morris County (Total)	4,547	7,586	\$188,743,849.21	519	283	2,745

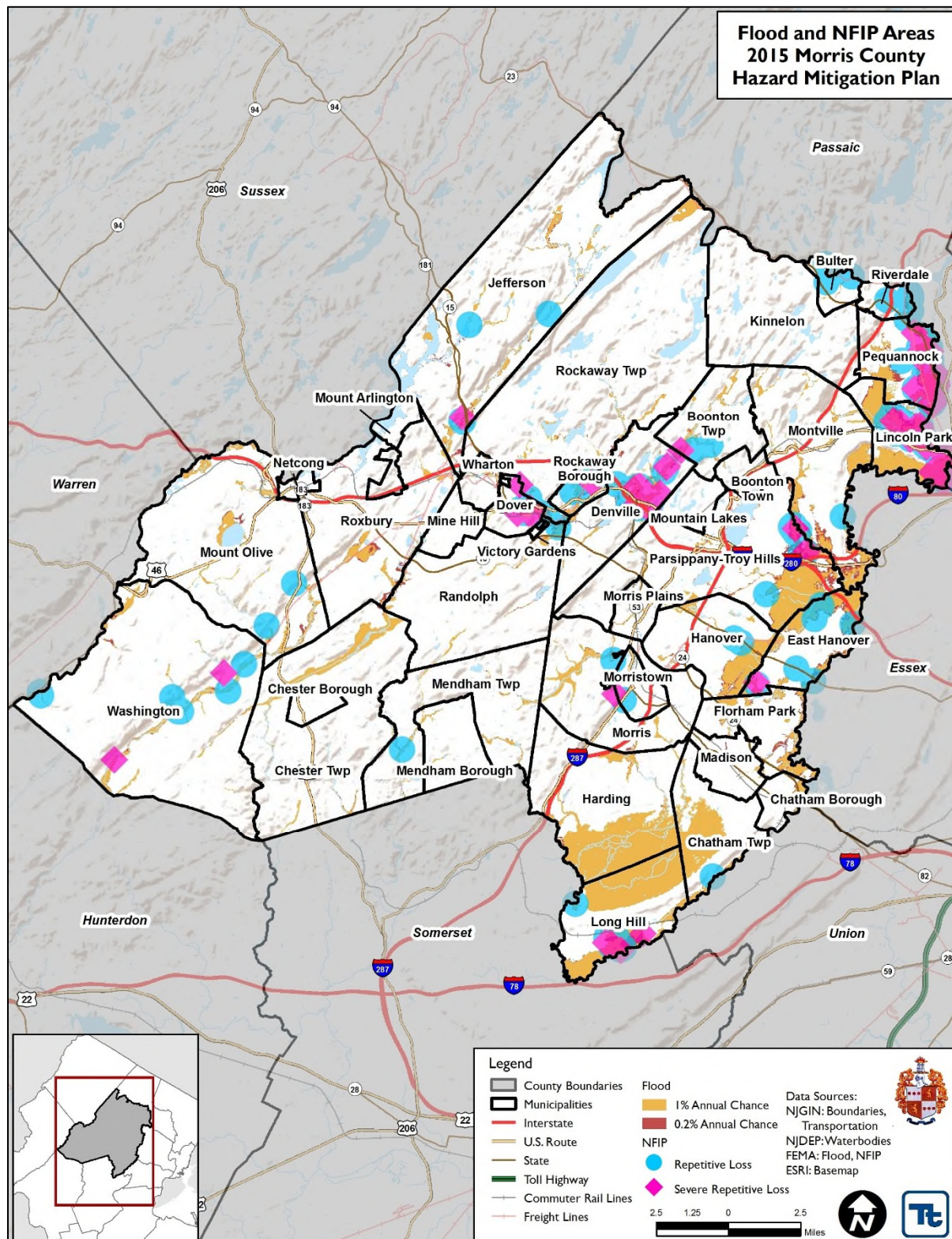
Source: FEMA Region 2, 2014

- (1) Policies, claims, repetitive loss and severe repetitive loss statistics provided by FEMA Region 2, and are current as of 9/30/2014.
Please note the total number of repetitive loss properties includes the severe repetitive loss properties. The number of claims represents claims closed by 9/30/14.
- (2) Total building and content losses from the claims file provided by FEMA Region 2.
- (3) The policies inside and outside of the flood zones is based on the latitude and longitude provided by FEMA Region 2 in the policy file.
The number of policies in the flood boundary was calculated using the 2012 FEMA preliminary DFIRM

Notes: FEMA noted that where there is more than one entry for a property, there may be more than one policy in force or more than one GIS possibility.
A zero percentage denotes less than 1/100th percentage and not zero damages or vulnerability as may be the case.
Number of policies and claims and claims total exclude properties located outside County boundary, based on provided latitude and longitude.



Figure 5.4.5-3. NFIP Repetitive Loss Areas – Morris County



Source: FEMA Region 2, 2014



Impact on Critical Facilities

HAZUS-MH was used to estimate the flood loss potential to critical facilities exposed to the flood risk. Using depth/damage function curves, HAZUS estimates the percent of damage to critical facilities. Table 5.4.5-10 and Table 5.4.5-11 summarize the number of critical facilities located in the FEMA flood zones by type and by jurisdiction.

In cases where short-term functionality is impacted by a hazard, other facilities of neighboring municipalities may need to increase support response functions during a disaster event. Mitigation planning should consider means to reduce impact to critical facilities and ensure sufficient emergency and school services remain when a significant event occurs. Actions addressing shared services agreements are included in Section 9 (Mitigation Strategies) of this plan.



Table 5.4.5-10. Number of Critical Facilities Located in the One-Percent Annual Chance Flood Zone

Municipality	Facility Types																	
	Air	Bus	Communication	Dam	DPW	EMS	Emergency Operation Center	Fire Station	Hazardous Material	Library	Municipal Hall	Natural Gas Facility	Police Station	Potable Water Facility	Potable Water Pump	School	Senior	Wastewater Facility
Town of Boonton	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Boonton	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Borough of Butler	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Chatham Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Chatham Township	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chester Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chester Township	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Denville Township	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Town of Dover	0	1	0	0	0	0	1	1	0	1	1	0	1	0	0	1	1	0
Township of East Hanover	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Borough of Florham Park	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Hanover	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0
Township of Harding	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Jefferson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Borough of Kinnelon	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Borough of Lincoln Park	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
Township of Long Hill	0	0	1	0	1	0	1	1	0	0	1	0	1	0	0	0	0	2
Borough of Madison	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Borough of Mendham	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Mendham	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Township of Mine Hill	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Montville	0	0	0	1	0	0	0	1	1	0	0	0	0	0	1	0	0	0
Borough of Morris Plains	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



Table 5.4.5-10. Number of Critical Facilities Located in the One-Percent Annual Chance Flood Zone

Municipality	Facility Types																	
	Air	Bus	Communication	Dam	DPW	EMS	Emergency Operation Center	Fire Station	Hazardous Material	Library	Municipal Hall	Natural Gas Facility	Police Station	Potable Water Facility	Potable Water Pump	School	Senior	Wastewater Facility
Township of Morris	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0
Town of Morristown	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Borough of Mount Arlington	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Mount Olive	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Borough of Mountain Lakes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Netcong Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Parsippany-Troy Hills	0	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Pequannock	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Township of Randolph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Borough of Riverdale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Borough of Rockaway	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0
Township of Rockaway	0	0	0	3	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Township of Roxbury	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Borough of Victory Gardens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Washington	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Borough of Wharton	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morris County (Total)	1	2	2	18	4	1	2	5	3	1	2	2	3	1	1	2	1	7

Source: FEMA 2012, 2015, Morris County



Table 5.4.5-11. Number of Critical Facilities Located in the 0.2-Percent Annual Chance Flood Zone

Municipality	Facility Types																			
	Air	Bus	Communication	Dam	DPW	Electric Power	EMS	Emergency Operation Center	Fire Station	Hazardous Material	Library	Medical	Municipal Hall	Natural Gas Facility	Police Station	Potable Water Facility	Potable Water Pump	School	Senior	Wastewater Facility
Town of Boonton	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Boonton	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Borough of Butler	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chatham Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Chatham Township	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chester Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chester Township	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Denville Township	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
Town of Dover	0	1	0	0	0	0	0	1	1	0	1	0	1	0	1	0	0	1	1	0
Township of East Hanover	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Borough of Florham Park	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Hanover	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
Township of Harding	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Jefferson	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Borough of Kinnelon	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Borough of Lincoln Park	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
Township of Long Hill	0	0	1	0	1	0	1	2	1	0	1	0	2	0	1	0	0	0	0	2
Borough of Madison	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Borough of Mendham	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Mendham	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Township of Mine Hill	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Montville	0	2	0	1	1	0	0	0	2	1	0	0	0	0	0	0	1	0	0	0
Borough of Morris Plains	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



Table 5.4.5-11. Number of Critical Facilities Located in the 0.2-Percent Annual Chance Flood Zone

Municipality	Facility Types																			
	Air	Bus	Communication	Dam	DPW	Electric Power	EMS	Emergency Operation Center	Fire Station	Hazardous Material	Library	Medical	Municipal Hall	Natural Gas Facility	Police Station	Potable Water Facility	Potable Water Pump	School	Senior	Wastewater Facility
Township of Morris	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1
Town of Morristown	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Borough of Mount Arlington	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Mount Olive	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Borough of Mountain Lakes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Netcong Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Parsippany-Troy Hills	0	1	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1
Township of Pequannock	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Township of Randolph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Borough of Riverdale	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Borough of Rockaway	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
Township of Rockaway	0	0	0	3	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Township of Roxbury	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0
Borough of Victory Gardens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Washington	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Borough of Wharton	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morris County (Total)	1	5	2	19	5	1	2	4	8	5	2	1	4	2	3	1	1	6	1	10

Source: FEMA 2012, 2015, Morris County



Impact on the Economy

For impact on economy, estimated losses from a flood event are considered. Losses include but are not limited to general building stock damages, agricultural losses, business interruption, impacts to tourism and tax base to Morris County. Damages to general building stock can be quantified using HAZUS-MH as discussed above. Other economic components such as loss of facility use, functional downtime and social economic factors are less measurable with a high degree of certainty.

Flooding can cause extensive damage to public utilities and disruptions to the delivery of services. Loss of power and communications may occur; and drinking water and wastewater treatment facilities may be temporarily out of operation. Flooded streets and road blocks make it difficult for emergency vehicles to respond to calls for service. Floodwaters can wash out sections of roadway and bridges (Foster, Date Unknown). In addition to travel along the roadways, public transit will be greatly impacted, causing problems for emergency responders.

Direct building losses are the estimated costs to repair or replace the damage caused to the building. Refer to the ‘Impact on General Building Stock’ subsection which discusses these potential losses. These dollar value losses to the County’s total building inventory replacement value, in addition to damages to roadways and infrastructure, would greatly impact the local economy.

HAZUS-MH estimated the amount of debris generated from the one-percent annual chance flood event. The model breaks down debris into three categories: 1) finishes (dry wall, insulation, etc.); 2) structural (wood, brick, etc.) and 3) foundations (concrete slab and block, rebar, etc.). The distinction is made because of the different types of equipment needed to handle the debris. Table 5.4.6-15 summarizes the debris estimated for the one-percent flood annual chance event.

Please note this table only represents estimated debris generated by riverine flooding and does not include additional potential damage and debris which may be generated with the presence of wind.

Table 5.4.5-12. Estimated Debris Generated from the one-percent Flood Event

Municipality	1% Flood Event			
	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
Town of Boonton	232	163	40	30
Township of Boonton	1,237	858	230	150
Borough of Butler	318	262	34	22
Chatham Borough	208	202	4	2
Chatham Township	268	268	0	0
Chester Borough	0	0	0	0
Chester Township	49	49	0	0
Denville Township	5,075	3,485	958	631
Town of Dover	765	742	14	9
Township of East Hanover	4,584	4,581	2	1
Borough of Florham Park	1,257	1,222	22	14
Township of Hanover	2,229	2,086	86	57
Township of Harding	429	410	12	7
Township of Jefferson	983	916	38	29
Borough of Kinnelon	0	0	0	0
Borough of Lincoln Park	10,016	6,237	2,231	1,548

**Table 5.4.5-12. Estimated Debris Generated from the one-percent Flood Event**

Municipality	1% Flood Event			
	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
Township of Long Hill	1,568	1,568	0	0
Borough of Madison	54	54	0	0
Borough of Mendham	91	90	1	0
Township of Mendham	185	183	2	1
Township of Mine Hill	19	19	0	0
Township of Montville	2,232	1,739	301	192
Borough of Morris Plains	283	255	18	11
Township of Morris	350	350	0	0
Town of Morristown	113	111	1	1
Borough of Mount Arlington	9	9	0	0
Township of Mount Olive	702	641	37	24
Borough of Mountain Lakes	0	0	0	0
Netcong Borough	23	23	0	0
Township of Parsippany-Troy Hills	3,424	2,893	312	219
Township of Pequannock	16,970	5,955	6,700	4,314
Township of Randolph	675	628	28	19
Borough of Riverdale	946	562	225	160
Borough of Rockaway	598	440	97	61
Township of Rockaway	717	611	63	44
Township of Roxbury	373	365	5	3
Borough of Victory Gardens	16	16	0	0
Township of Washington	508	458	29	21
Borough of Wharton	97	97	0	0
Morris County (Total)	57,605	38,545	11,488	7,571

Source: HAZUS-MH 2.1

Effect of Climate Change on Vulnerability

Climate is defined not simply as average temperature and precipitation but also by the type, frequency and intensity of weather events. Both globally and at the local scale, climate change has the potential to alter the prevalence and severity of extremes such as flood events. While predicting changes of flood events under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating future climate change impacts on human health, society and the environment (U.S. Environmental Protection Agency [EPA], 2006).

Change of Vulnerability

Morris County and its municipalities continue to be vulnerable to the flood hazard. However, there are several differences between the exposure and potential loss estimates between this plan update to the results in the original 2010 HMP. Their differences are due to the new and updated population (U.S. Census 2010 is now available) and building inventories used, and more accurate flood depth grids used to estimate potential losses in HAZUS-MH due to the availability of their DFIRM.

Differences in exposure and potential losses estimated from the 2010 HMP can be attributed to the difference in building stock inventory and methodology used for the risk assessment. For example, the 2010 HMP building



inventory was the default HAZUS-MH general building stock with replacement values based on 2006 RS Means. For this plan update, the potential loss analysis was conducted using a custom County-wide building inventory using the MODIV tax assessment data. The 2010 HMP potential loss estimates were only summarized at the County level for each occupancy class; however the 2015 update estimates potential losses at the structure level using the updated building inventory and summarized for each municipality.

For this plan update, an updated NJDEP depth grid, generated using 2015 FEMA preliminary DFIRM maps, was combined with the 2014 New Jersey State HMP depth grid generated for Morris County. The depth grids were integrated into HAZUS-MH, and the model was run to estimate potential losses at the structure level utilizing the custom building inventory developed for this plan update.

Overall, this vulnerability assessment uses a more accurate and updated building inventory and updated flood mapping which provides more accurate estimated exposure and potential losses for Morris County.

Future Growth and Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the County. Any areas of growth could be potentially impacted by the flood hazard if located within the identified hazard areas. Figure 5.4.5-4 illustrates the identified areas of potential new development in relation to the flood boundaries. It is the intention of the County and all participating municipalities to discourage development in vulnerable areas or to encourage higher regulatory standards on the local level.

Additional Data and Next Steps

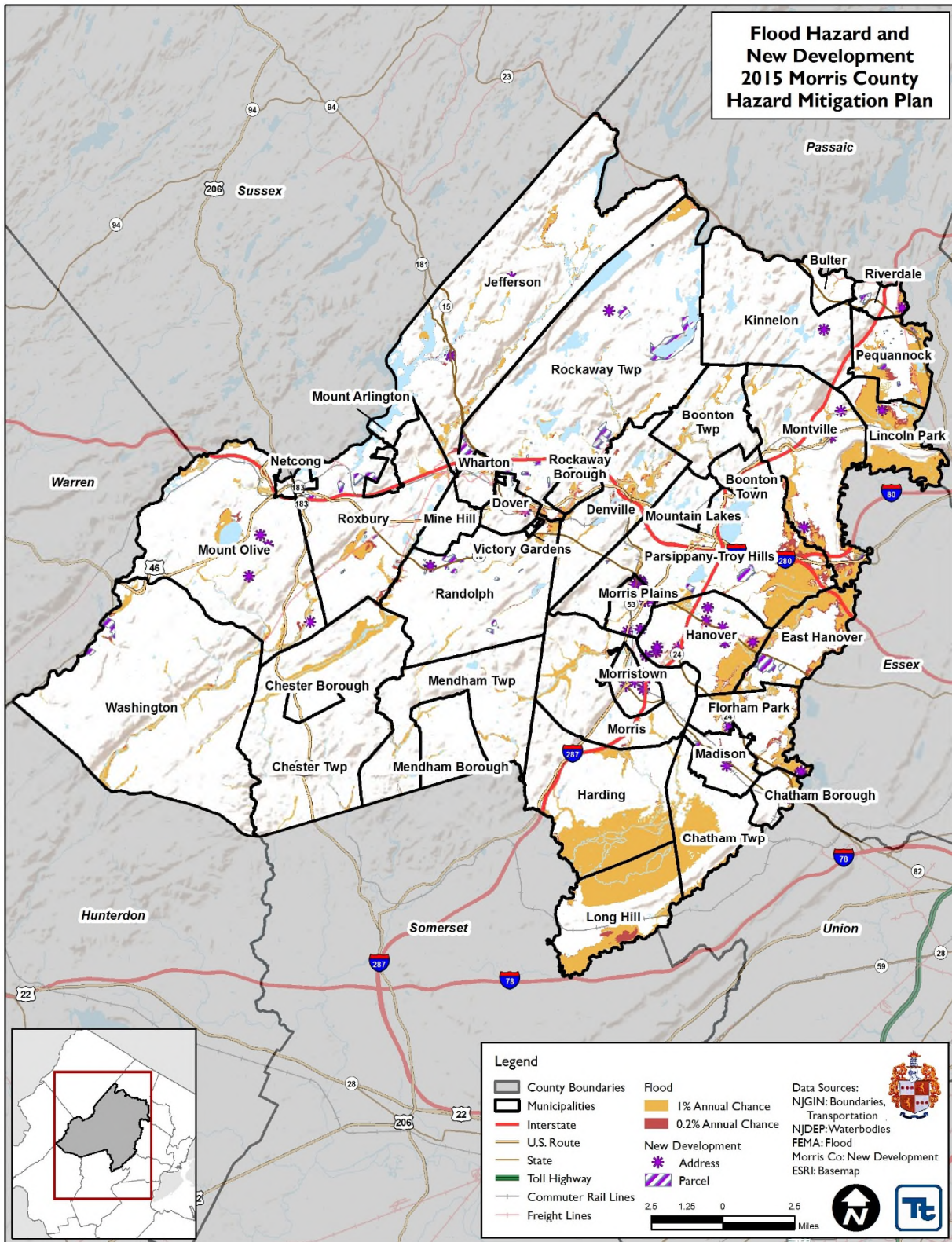
A HAZUS-MH flood analysis was conducted for Morris County using the most current and best available data including updated building and critical facility inventories, and DFIRM. For future plan updates, more accurate loss estimates can be produced by replacing the national default demographic inventory with 2010 U.S. Census data when it becomes available in the HAZUS-MH model.

As additional FEMA Risk Mapping, Assessment, and Planning (Risk MAP) products become available, these may be used to further enhance this assessment (e.g. depth grids for additional recurrence intervals).

Specific mitigation actions addressing improved data collection and further vulnerability analysis is included in Volume II, Section 9 of this plan.



Figure 5.4.5-4. Potential New Development and Flood Boundaries



Source: FEMA 2015, Morris County